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ABSTRACT

This paper describes a program at Old Dominion University (ODU) which engages qualified graduate students in a professional research/design experience while simultaneously providing the academic environment for full-time study. During the two years, students are provided a stipend and tuition expenses under a study grant from the National Aeronautics and Space Administration Langley Research Center (NASA/LRC), Hampton, Virginia. Masters students and a few Ph.D. students are selected for the program. During the second year, students engage in actual engineering research and design at NASA/LRC. Sections of the paper describe (1) the ODU interdisciplinary approach to graduate aeronautics education, combining strengths from major engineering disciplines; (2) methods of student selection, study program planning, placement in NASA/LRC branches, student advisement, and research supervision; (3) degree production and current status of program; and (4) reception of the program by NASA management and engineers, the engineering faculty, and the students in the program. Evidence presented indicates that mutual benefits from the program accrue for the students, the engineering school, and the cooperating agency. (LS)

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COOPERATIVE NASA-OLD DOMINION UNIVERSITY GRADUATE STUDY AND RESEARCH PROGRAM IN AERONAUTICS

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ABSTRACT

A joint venture in graduate engineering education is described in terms of the successes and problems which have resulted from the cooperative program in aeronautics. Sections of the paper describe (1) the ODU interdisciplinary approach to graduate aeronautics education, combining strengths from major engineering disciplines, (2) methods of student selection, study program planning, placement in NASA Langley Research Center branches, student advisement and research supervision, (3) degree production and current status of program, and (4) reception of the program by NASA management and engineers, the engineering faculty, and the students in the program. Evidence presented indicates that mutual benefits accrue for the students who gain a first-hand experience in applied research and design, and to the Engineering School which can attract students to a funded program and broaden the base of faculty research, and finally to the cooperating agency or industry (in this case NASA/LRC) which gains technical assistance for projects and is able to promote expertise in the aeronautics industry.

INTRODUCTION

In recent years there has been an increasing call for joint participation in aeronautical education between universities, government, and industry. The matter was succinctly addressed by all three components last year at the joint NASA/University Conference on Aeronautics [1]*. Various mechanisms are being employed to enhance the production of engineering graduates who by virtue of interest and preparation will assume responsible positions in a diverse aeronautics industry. As recently as last June, Robert Courter reported at the 1974 ASEE Annual Conference on a cooperative graduate engineering program operating between the Louisiana State University in Baton Rouge and the NASA Johnson Space Center [2]. The objective of that program was to provide a "hands-on" graduate engineering educational experience, to couple faculty, students and NASA engineers. The school of engineering at Old Dominion University operates a related but distinct program from the Virginia Associated Research Campus (VARC) in Newport News, Virginia.

The program, which commenced in 1971, has as a primary purpose the engagement of qualified graduate students in a professional research/design experience while simultaneously providing the academic environment for full-time study. The time-frame for the program is two calendar years. During this period, students are provided a stipend and tuition expenses under a study grant f[illegible]NASA Langley Research Center, Hampton, Virginia. Masters students and a[illegible] Ph.D. students, with aeronautics interests, are selected for the program. The first year is used essentially for full-time study, although placement of student in an appropriate branch at NASA/LRC is made

*Numerals in brackets refer to the list of references.

as soon as a student begins the program. The second year is designated for full-time research except for an occasional course which might be taken to support thesis research or otherwise to satisfy degree requirements. It is the intent of this paper to demonstrate that within this framework a viable mechanism operates to prepare engineers for aeronautics work especially at the Masters level.

To accommodate the graduate research participation program in aeronautics, the school of engineering draws upon appropriate faculty talent which has developed within the three graduate departments: Civil Engineering, Electrical Engineering, and Mechanical Engineering and Mechanics. The cooperative program is administrated from the graduate campus in Newport News, Virginia. Students find study space, library resources, faculty advisement, and most graduate instruction at the Virginia Associated Research Campus (VARC). The nature of the dual-campus graduate operation was discussed more fully at a recent IEEE workshop [3].

The key point relating to the cooperative ODU/NASA/LRC program in aeronautics is to note that the educational philosophy in the school of engineering, extending through the masters level, is strongly "core" based. The faculty have identified fundamental knowledge and basic skills that need be assimilated by all engineering students prior to specialization. Therefore, it is felt that specialization in the several aeronautics areas developed by the faculty, largely as a result of their relationship with NASA/LRC, is best built upon a foundation of fundamentals drawn from the three engineering departments plus mathematics. Students can complete the program with a Master of Engineering or Ph.D. degree with concentration in one of the three departmental disciplines.

STUDENT SELECTION AND ADVISEMENT

Students are solicited on a nationwide basis with the main requirements being that candidates meet graduate school admission requirements, have a B.S. in science or engineering, and indicate an interest in graduate study with an aeronautics emphasis. Candidates for the program must display not only acceptable academic credentials, but also behavior traits that indicate a potential for interacting productively with a variety of advisors and peers, show poise and self-starting capabilities. Awardees are selected by the associate dean at VARC in consultation with the appropriate departmental graduate program director. Aeronautics research students are enrolled in a department commensurate with their background and interest. Each new student is introduced immediately to engineers in several branches at NASA/LRC through contacts made by graduate faculty and the program administrator. As soon as a match of interests is made, the student begins spending a limited time in the NASA Laboratories under supervision of a NASA engineer who becomes a co-chairman of the student's evaluation committee. Simultaneously, a faculty member voices an interest in the student's topical area for research and study and is designated as evaluation committee co-chairman. In point of fact, a three-way match of interest is determined. The evaluation and advisement committee is formally appointed by the student's departmental chairman and has at least three members, a majority of whom are ODU faculty members. Student research projects are planned during the first year, with each participating NASA branch suggesting several projects of interest to the student; the student and his committee make the decisions during the first year. Masters students have no difficulty completing all requirements including a thesis within the two-year format. Those few Ph.D. students (usually brought to the

program on strong faculty recommendation) understand that the program provides a stipend for two years only; other arrangements must usually be made for continuation. Faculty advisors become more or less involved with the student research project, but the faculty committee co-chairman is chosen so that he brings some expertise to the work of the NASA branch. The faculty evaluation committee co-chairman is responsible to the academic department chairmen for determining that candidates complete all degree requirements. The NASA advisor is very instrumental in research/design project planning, but also is a full participant in evaluation of student progress; when appropriate, NASA advisors are offered adjunct or research appointments in the school of engineering. Every effort is made to encourage a three-way cooperative learning experience.

CURRENT STATUS OF PROGRAM

Students who receive appointments to the aeronautics research participation program gain a stipend of $5000 per year for two years plus tuition expenses[1]. This substantial stipend is not, however, sufficient impetus to gain as many qualified applicants for the program as would be desired. The central idea is the "quality" of the applicants; bidding for the relatively few talented new graduates with aeronautics interests has been keen over the last two or three years. The program currently enrolls four students, will add two new participants in the Fall, and has graduated eight people with the Master of Engineering degree. The four current students are all enrolled in the department of mechanical engineering and mechanics; Table I displays other characteristics of these students.

[1] These awards are made possible by virtue of the aforementioned study grant with NASA Langley Research Center.

Table I. Characteristics of Current Students

Student	Status	Degree Sought	Project Identifier
1	1st yr.	M.E.	Supersonic Jet Noise Phenomena
2	1st yr.	M.E.	Radiative Exchange in Earth Atmosphere
3	2nd yr.	M.E.	Aircraft Spin Characteristics
4	2nd yr.	Ph.D.	Optimal Control of Spacecraft

Eight program participants have graduated with the Master of Engineering degree; two out of the eight were women. No awardee has failed to meet the standards of the program; however, the first graduate appearing in Table II. was allowed to elect a non-thesis option, although he was responsible for project work at NASA/LRC; and, one person has discontinued the program for personal reasons. The theses titles in Table II. indicate specialty areas engaging the students and their advisors. The predominance of enrollees in the department of mechanical engineering and mechanics is somewhat artificial since two separate departments were recently combined.

A significant purpose of the NASA/ODU cooperative program is to produce graduates who will assume positions in aeronautics industry. The extent to which this has been achieved with the eight graduates of the program is displayed in Table III.

Table III. Employment Record

Engineering Work		Not Employed
Aero	Non-aero	
4	3	1 (Fullbright Fellow)

TABLE II. PROGRAM GRADUATES

MASTER OF ENGINEERING DEGREE

Name	Undergrad. School	Academic yr. of Completion	Dept.	Thesis Title
John E. Carr	ODU	1971-72	Electrical	None
Joan P. Gosink	MIT	1972-73	Mechanical & Mechanics	Numerical Study of the Turbulent Boundary Layer in a Hypersonic Nozzle
Joanne L. Walsh	ODU	1973-74	Mechanical & Mechanics	Computer-Aided Design of Light Aircraft To Meet Certain Aerodynamic and Structural Requirements
Leroy F. Albang	Iowa State	1974-75	Mechanical & Mechanics	Analysis of Spread Multi-Jet VTOL Aircraft in Hover
Garla Arjuna	Anantapur, India	1974-75	Mechanical & Mechanics	The Effect of Unreinforced Cutouts on the Buckling of Thin Conical Shells Loaded by Central Axial Compression
Michael H. Berger	ODU	1974-75	Mechanical & Mechanics	Application of Boundary Layer Theory to Suction through Streamwise Slots in Wind Tunnel Walls
J. Philip Drummond	UVA	1974-75	Mechanical & Mechanics	A Method for Improving the Accuracy in Phase Change Heat Transfer Data through Increased Precision in Thermophysical Property Determination
Joseph T. Fuss	Rose-Hulman	1974-75	Mechanical & Mechanics	Dynamics of Explosion Remnants in Earth-Orbits

All eight graduates are employed in such a way as to use their engineering skills, 50% of them in aeronautics-related work. Ms. Gosink, listed in Table II, is the "unemployed" engineer who is currently studying as a Fullbright Fellow in England. The "steady state" annual cost of the program, assuming four students actively engaged year-around on the average, is approximately $40,000 with 60% of this applied to student stipends and tuition. No direct cost for student participation is borne by the participating NASA/LRC branches.

PROGRAM RECEPTION

It is most gratifying that NASA/LRC engineers and their first line management have found the cooperative program appropriate for and consistent with their needs, in terms of program administration and the technical assistance which has been provided. The best measure of this level of satisfaction has been the discovery over the last two or three years that there are several times more projects and job slots at NASA/LRC wanting research assistants than there are students enrolled in the program. Top management at NASA/LRC can take satisfaction in knowing that a supported program, although small in people and dollars, is producing qualified engineers for selected aeronautics specialties. The School of Engineering is pleased with the program because it compliments the basic mission of graduate engineering education, which is to conjoin students, faculty, and practioners of engineering in a productive, learning environment. It may be difficult to show that the program is "profitable" for the University as a whole, in that relatively small numbers of students are attended by an expensive faculty. Finally, from the student point of view a graduate, professional level experience is gained. The

cooperative program participants take leave of the closed society of graduate student peers to engage in actual engineering research and design. They trade peers in the traditional sense for a realistic communications experience involving academic engineers (the faculty), NASA engineers and technicians, and the administrators of the program. Most of the participants recognize the advantages of their experience. Nearly all participants have been better-than-average graduate students and program graduates have had little difficulty obtaining a job of preference.

REFERENCES

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